PARISHRAM 2024

- FOR 12TH CLASS CBSE BOARD STUDENTS -

CHEMISTRY

ELECTROCHEMISTRY

Lecture No.- 07

By- Harsha Soni Ma'am

Today's Targets

1. Conductance

CONDUCTANCE

Substances which allow electricity to pass through them are know as conductors. Substances which do not allow electricity to pass through them are called Insulators.

⇒ Conductors = allow electricity to pass.

Electronic Conductors

Eg = Metals, Graphite etc.

Electrolytic Conductors

Eg = Electrolytes.

ELECTRONIC CONDUCTORS

- Those which conducts electricity without undergoing any decomposition
- E.g. Metals, Graphite and certain minerals.
- Here the cause of conduction is due to flow of electrons.

ELECTROLYTIC CONDUCTORS

Electrolytes.

- Those which undergo decomposition when current is passed through them.
- E.g. Solution of acids, bases and salts in water, fused salts etc.
- Here the cause of conduction is due to flow of ions, hence also called ionic conductance.

→ Electrolytes = which dissociate to give ions

↳ Conduction of Electricity.

Strong

Weak

STRONG ELECTROLYTES

- Electrolytes which dissociates completely in aqueous solution or in the molten state.
- They conduct electricity to a large extent. → conduction of electricity that depends on no. of ions.

Eg: $HCl \longrightarrow H^+ + Cl^-$

$t=0$: 1, 0, 0

$t=\text{end}$: $\boxed{1-\alpha \quad \alpha \quad \alpha}$

$1-1 = 0$, $1 = 1$, $1 = 1$

↓ completely dissociate.

*) $\alpha = 1$ strong.

WEAK ELECTROLYTES

incomplete dissociation.

These dissociates into ions in small extent. They do not conduct electricity to a large extent.

(conduction ∝ no. of ions)

E.g. Weak acids = CH_3COOH, HCN, H_2CO_3, H_3PO_4 etc.

Weak bases = NH_4OH, $Li(OH)$, $Al(OH)_3$ etc.

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$t=0 \quad 1 \quad 0 \quad 0$

$t = t\,sec \quad \boxed{1-\alpha \quad \alpha \quad \alpha}$

* $\alpha < 1$

DEGREE OF IONISATION

20% dissociation → % = 20 → fraction = 0.2

Dissociation complete (100% diss)

- Fraction of total no. of molecules of electrolytes which ionizes in solution is called degree of ionization represented by α.
- For $\boxed{\text{Strong electrolytes } \alpha = 1}$
- For $\boxed{\text{Weak electrolytes } \alpha < 1}$

$\boxed{\text{Ostwald's Dilution Law}}$

(Weak) ($\alpha < 1$)

i) $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

	CH_3COOH	CH_3COO^-	H^+
t=0	c	0	0
t=eq. (equilibrium)	$c - c\alpha$	$c\alpha$	$c\alpha$

$$K_{eq} = \frac{[\text{Product}]}{[\text{Reactant}]}$$

$$K_{eq} = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$$\boxed{K_{eq} = \frac{[c\alpha][c\alpha]}{[c - c\alpha]}}$$

$$\boxed{K_{eq} = \frac{c\alpha^2}{1-\alpha}}$$

$$\boxed{K_a = \frac{c\alpha^2}{1-\alpha}}$$

$\alpha << 1$ **

$$\boxed{K_a = c\alpha^2}$$

$1 - \alpha \approx 1$

$$\boxed{\alpha = \sqrt{\frac{K_a}{c}}}$$

(Weak)

NON ELECTROLYTES

↳ do not ionise to give ions.

Substances like sugar, urea etc. which do not conduct electricity.

FACTORS AFFECTING ELECTROLYTIC CONDUCTION

1) NATURE OF ELECTROLYTE
2) NATURE OF SOLVENT
3) SIZE OF IONS IN WATER
4) TEMPERATURE
5) CONCENTRATION OF SOLUTION

Dipole-dipole (hydrogen bonding)

1.) Nature of Electrolyte

→ Conduction ∝ no. of ions.

→ $\boxed{\text{strong} > \text{weak} = \text{no. of ions}}$

strong ↓ $\boxed{\alpha = 1}$

weak ↓ $\boxed{\alpha < 1}$

2.) Nature of Solvent

Some solvent are highly viscous. ∴ movement of ions is slow.

3.) Size of ions in water

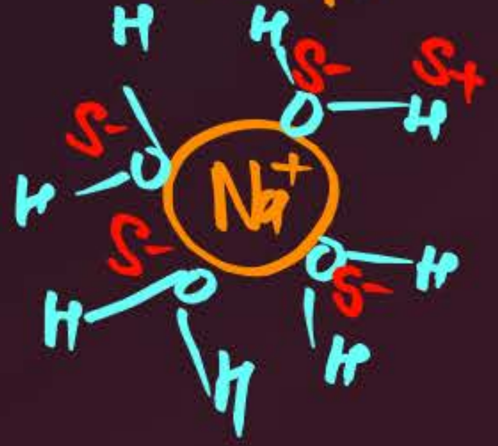
$NaCl \rightarrow Na^+ + Cl^-$

H_2O (solvent)

•) $\boxed{NaCl \rightarrow Na^+ + Cl^-}$ = solvation of Na^+ & Cl^- ions.

•)

$Na^+(aq)$



$Cl^-(aq)$

ion-dipole interaction

Gp I

Li | size ↑
Na
K ↓

→ $\boxed{\text{Solvation / hydration}} \propto \boxed{\dfrac{\text{charge}}{\text{radius}}}$

Eg: LiCl NaCl KCl = Solubility order?

$LiCl \rightarrow Li^+ + Cl^-$ $NaCl \rightarrow Na^+ + Cl^-$ $KCl \rightarrow K^+ + Cl^-$

$\Rightarrow \left(\dfrac{\text{Charge}}{\text{Radius}}\right) = \boxed{\dfrac{+1}{1} > \dfrac{+1}{2} > \dfrac{+1}{3}}$

$\Rightarrow$ hydration $= \boxed{Li^+ > Na^+ > K^+}$

$\Rightarrow$ (hydration $\propto$ solubility)

→ mobility of ions (movement)

$\boxed{\text{Mobility} \propto \dfrac{1}{\text{hydration}}}$

Eg: Li^+, Na^+, K^+

★ Aqs solution = ionic mobility?

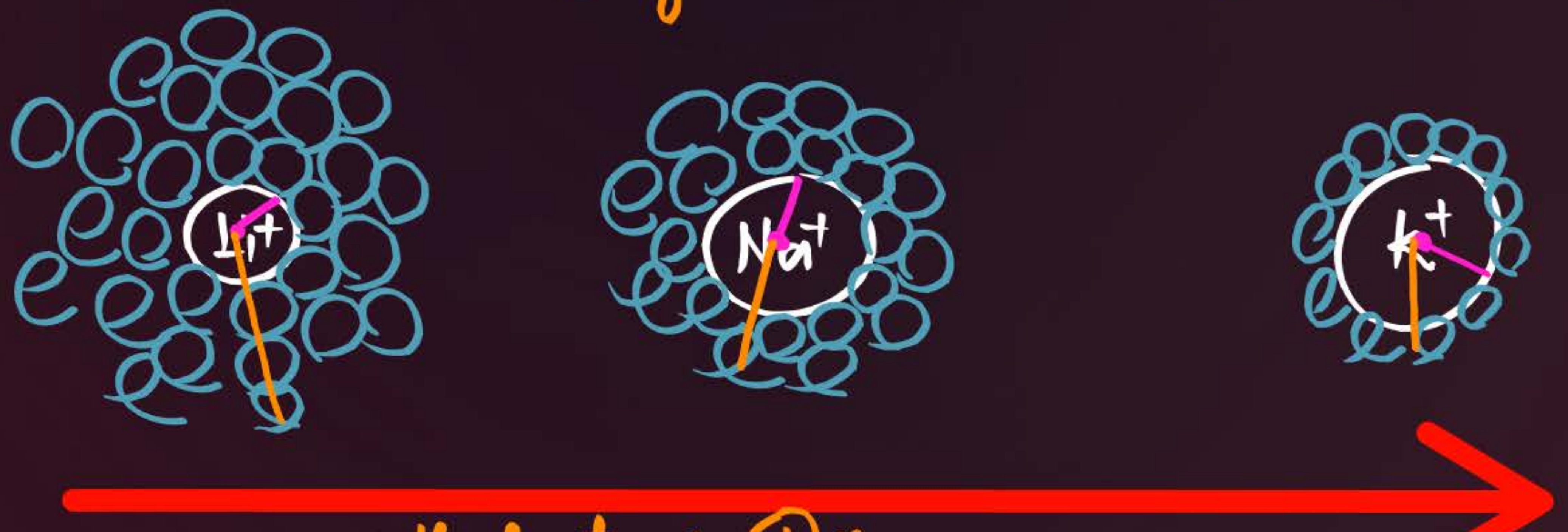
Ans:
mobility = $\boxed{K^+ > Na^+ > Li^+}$

Reason: Li^+ is most hydrated therefore its movement will be slowest.

→ Solvation

i) Ionic Radii = $K^+ > Na^+ > Li^+$

2) Hydrated Radii = $Li^+ > Na^+ > K^+$



✓ Hydration = $\downarrow$

✓ Ionic mobility = $\uparrow$

Q) Electrolytic conductance.
movement of ions compare. or conductance?

i) KCl(aq), CsCl(aq)

ii) LiCl(aq), $BeCl_2$(aq)

Ans: $\boxed{\text{Conductance} \propto \text{movement of ions}}$

(i) $\frac{\text{Charge}}{\text{Radius}} = \boxed{\underset{K^+}{\frac{+1}{r_{K^+}}} > \underset{Cs^+}{\frac{+1}{r_{Cs^+}}}}$

$(r_{K^+} < r_{Cs^+})$

Ans = $K^+ > Cs^+$
hydration
ionic mobility
$\boxed{Cs^+ > K^+}$

Conductance = CsCl > KCl

ii) LiCl, $BeCl_2$
Li^+ Be^{+2}

$\frac{\text{Charge}}{\text{Radius}} = \boxed{\frac{+1}{r_{Li^+}} < \frac{+2}{r_{Be^{+2}}}}$

$r_{Li^+} > r_{Be^{+2}}$

hydration: $Be^{+2} > Li^+$

ionic mobility = $Li^+ > Be^{+2}$

Conductance =
$\boxed{LiCl > BeCl_2}$

4) Temperature

$\boxed{\text{temp} \propto \text{dissociation of Electrolyte} \propto \text{no. of ions} \propto \text{Conductance}}$

5) Concentration of Solution

→ Strong electrolyte ($\alpha = 1$)
complete dissociation (100%)

→ Weak Electrolyte ($\alpha < 1$) → $\boxed{\alpha = \sqrt{\frac{K_a}{C}}}$
incomplete diss. (less than 100%)

$\Rightarrow \alpha = \sqrt{\frac{K_a}{C}}$

$\Rightarrow \boxed{\alpha \propto \frac{1}{\sqrt{C}}}$

conc of soln (↓) = α = (↑) = degree of diss (↑)

Q) NH_4OH, Compare conductance
i) 0.2M NH_4OH ii) 2M NH_4OH

→ conductance $\propto \alpha$

→ $\alpha \propto \frac{1}{\sqrt{C}}$

→ $\boxed{\text{i)} > \text{ii)}}$

THANK YOU